

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
24 July 2003 (24.07.2003)

PCT

(10) International Publication Number  
**WO 03/059601 A1**

(51) International Patent Classification<sup>7</sup>: **B29C 53/08**

(21) International Application Number: **PCT/US03/00977**

(22) International Filing Date: 14 January 2003 (14.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/348,834 15 January 2002 (15.01.2002) US

(71) Applicant (for all designated States except US): **COOPER TECHNOLOGY SERVICES, LLC**. [US/US]; 701 Lima Avenue, Findlay, OH 45840 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **WOESSNER, David, Paul** [US/US]; 5641 Spencer Road, Mount Sterling, KY 40353 (US).

(74) Agents: **BUTCHKO, Karin, H.** et al.; Carlson, Gaskey & Olds, P.C., 400 West Maple Road, Suite 350, Birmingham, MI 48009 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

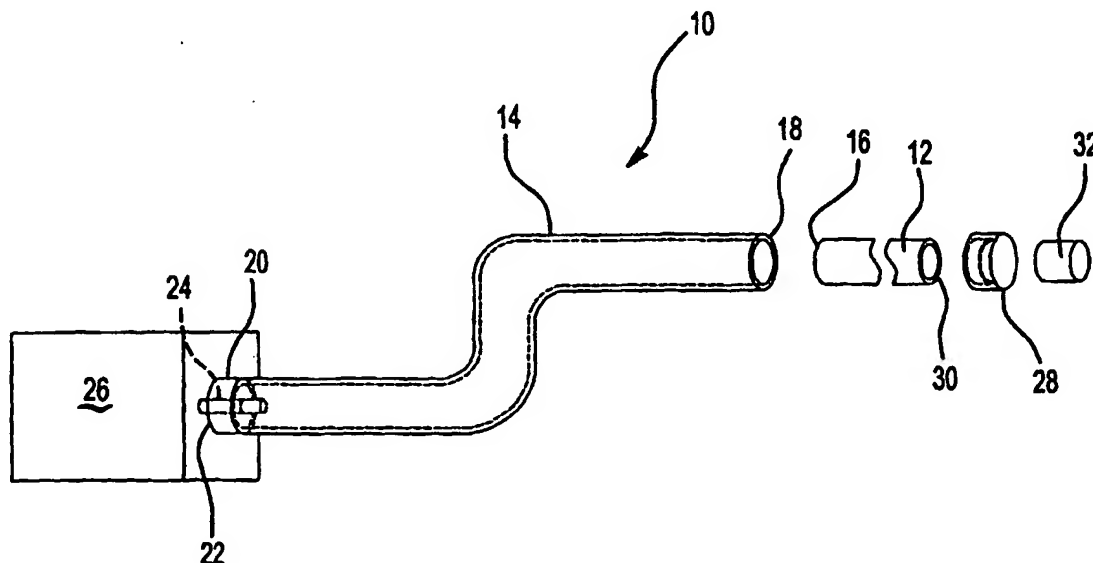
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

[Continued on next page]

(54) Title: METHOD OF FORMING A HOSE



(57) Abstract: A polymeric hose pre-form (12) is inserted into a pre-shaped tube (14) and formed into a desired shape. A vacuum endcap (20) is positioned on one end of the tube, and a vacuum is applied at the vacuum endcap to draw the hose pre-form through the tube. After insertion of the hose into the tube, the hose contacts the inner surface of the tube. A loading endcap (28) is positioned on the other end of the tube. The hose is then cured to maintain the hose in the shape defined by the tube. During curing, the pair of endcaps are flush against the ends of the hose, eliminating the need for a finishing operation. The cured hose is then removed from the tube. The ends of the hose can also be flared.

WO 03/059601 A1

**WO 03/059601 A1**



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# METHOD OF FORMING A HOSE

## BACKGROUND OF THE INVENTION

The present invention relates generally to a method of forming a hose to a  
5 desired shape by curing a polymeric hose pre-form inside a pre-shaped tube.

Hoses are commonly formed into a desired shape by manually sliding a hose  
pre-form over a metal mandrel bent to the desired shape. The metal mandrel is  
usually lubricated to facilitate loading of the metal mandrel in the hose pre-form.  
The hose is then cured to set the hose to the shape of the metal mandrel. During  
10 curing, the metal mandrel supports and retains the hose in the desired shape from the  
interior surface of the hose. After curing, the metal mandrel is removed. A  
finishing operation is commonly needed to finish the ends of the hose.

Hoses are also formed by helically winding hose tape around an internal  
mandrel having a desired shape. The tape is then cured to form the finished hose of  
15 the desired shape, and the mandrel is withdrawn.

Another prior method of forming a hose includes confining a hose pre-form  
inside a spirally shaped confining wall that provides exterior support. The confining  
wall includes a top half and a lower half. The hose is placed in the lower half of the  
confining wall, and the top half is then placed over the lower half to trap the hose.  
20 The confining wall provides exterior support as the hose is cured. A drawback to  
this method is that finishing operation is needed because the ends are trapped in the  
wall and that the confining wall leaves a seam on the hose.

Hoses are also cured while passing through a microwave zone. The outer  
surface of the tube is simultaneously contacted by a cool stream of fluid that cures  
25 the hose. In this method, the outer surface of the tube does not contact any structure  
or surface.

There are several drawbacks to forming a hose by the mandrel method of the  
prior art. For one, stress and strain injuries to the operator are possible while sliding  
of the hose pre-form over the mandrel. This method also requires additional space  
30 as there must be room around the parts for the operator's hands during assembly. A  
separate finishing operation is also required to finish the ends. Finally, this method  
is expensive and very difficult ergonomically.

### **SUMMARY OF THE INVENTION**

A polymeric hose pre-form is inserted into a pre-shaped tube and is formed into a desired shape. The hose pre-form is first cut to a desired length. A first end of the hose pre-form is inserted into a loading end of the tube. Preferably, the first end is lubricated to assist in loading of the tube. After loading is complete, the outer surface of the hose contacts the inner surface of the tube.

A vacuum endcap is positioned on an opposing vacuum end of the tube. A vacuum applied at the vacuum endcap draws the hose pre-form through the tube until the first end of the hose is flush with the vacuum endcap. A loading endcap is then positioned on the loading end of the tube. Preferably, both ends of the hose are flush with the endcaps and a finishing operation is not needed.

The hose is then cured to maintain the hose in the shape of the tube. After curing, the loading endcap is removed from the tube, and the cured hose is removed from the tube from the loading end.

If the inner diameter of one of the ends of the hose is required to be made larger or flared, a mandrel or plug is inserted into the desired end of the tube prior to curing. The mandrel or plug increases the size of the inner diameter of the hose. These and other features of the present invention will be best understood from the following specification and drawings.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

The various features and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows:

Figure 1 illustrates a schematic perspective view of the hose forming assembly of the present invention; and

Figure 2 illustrates a schematic cross-sectional view of the loading end of the tube after insertion of a mandrel or plug to enlarge the inner diameter of the hose.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Figure 1 illustrates the hose forming assembly 10 of the present invention. The assembly 10 cures and forms a polymeric hose pre-form 12 into a desired shape. The hose 12 is cured and formed to the desired shape in an external supporting tube  
5 14. The hose 12 can be formed of any polymeric material that cures, such as rubber or plastic. Preferably, the tube 14 is formed of a high temperature plastic, glass, Pyrex, ceramic, or a metal, such as aluminum or stainless steel.

The uncured hose pre-form 12 is first cut to a desired length. A first end 16 of the hose pre-form 12 is inserted into a loading end 18 of the tube 14. During  
10 loading of the hose 12, the tube 14 is held stationary by a clamping block. Preferably, the first end 16 is lubricated to assist in loading. As the first end 16 of the hose 12 is pulled through the tube 14, the lubrication spreads over the surface of the hose 12 to further assist in loading. The outer surface of the hose 12 contacts the inner surface of the tube 14 that defines the desired shape when loading is complete.

A vacuum endcap 20 is positioned on an opposing vacuum end 22 of the  
15 tube 14. A vent tube 24, such as a roll pin, is inserted into the vacuum endcap 20. The vacuum endcap 20 determines the outer diameter of the hose 12 as the point of contact of the endcap 20 and the hose 12. The vent tube 24 determines the inner diameter of the hose 12 as the point of contact of the vent tube 24 and the hose 12.  
20 A vacuum 26 connected to the vent tube 24 applies a vacuum that draws the hose 12 through the entire length of the tube 14 until the first end 16 of the hose 12 is flush with the vacuum endcap 20. The vacuum 26 is stopped once the hose 12 is positioned in the tube 14. Although a vacuum 26 is disclosed, it is to be understood that other methods can be employed to draw the hose 12 into the tube 14. For  
25 example, the hose 12 can be manually pulled into the tube 14.

As shown in Figure 2, a loading endcap 28 is positioned on the loading end 18 of the tube 14 after the hose 12 is positioned in the tube 14. The loading endcap 28 can also be employed to determine the inner diameter and outer diameter of the hose 12 at the loading end 18 of the hose 12. Preferably, the hose 12 is pre-cut to a  
30 length such that the second end 30 of the hose 12 is also flush with the loading endcap 28. The tube 14 is then removed from the clamping block.

The hose 12 is then cured to form the hose 12 in the shape defined by the tube 14. As known in the art, the hose 12 is cured at the appropriate time and temperature for the specific hose material utilized. In some examples, the hose 12 is cured by submerging the hose 12 and tube 14 in a fluidized bed of hot fluid (oils, salts, water). The hose 12 can also be cured by hot air, by an electric wrap, or by microwave. During curing, the pair of endcaps 20 and 28 are flush against the first end 16 and opposing second end 30, respectively, of the hose 12. The endcaps 20 and 28 create a flat surface for curing and eliminate the need for a finishing operation.

After curing, the loading endcap 28 is removed from the tube 14, and the cured hose 12 is removed from the tube 14 at the loading end 18. Any suitable pressure may be employed to unload the hose 12 from the tube 14. Preferably, a blowgun is employed at the vacuum end 22 to force the hose 12 out of the tube 14.

The inner diameter of the hose 12 is determined by extrusion. During curing, the hose 12 is subjected to pressure. As the endcap 20 includes a vent tube 24, the pressure on the inside and the outside of the hose 12 is equalized, preventing the hose 12 from collapsing during curing. One of the endcaps 22 and 28 must be allowed to vent to equalize the pressure inside the hose 12. In Figure 1, the endcap 22 is vented by the vent tube 24.

Preferably, the tube 14 includes a plurality of bends. After the hose 12 is cured and removed from the tube 14, the hose 12 retains the shape of the plurality of bends of the tube 14.

Preferably, the outer diameter A of the hose 12 is slightly less than the inner diameter B of the tube 14 to ease in loading. In one example, the hose 12 has an outer diameter A of 9/16 of an inch and is inserted into a tube 14 having an inner diameter B of 11/16 of an inch and an outer diameter C of 12/16 of an inch. In this example, the endcaps 20 and 28 each have an outer diameter D of 11/16 of an inch. The wall thickness E of the hose 12 is preferably greater than 0.065 of an inch in thickness to prevent the hose 12 from collapsing or tearing when bent to the desired shape. Although these dimensions have been described, it is to be understood that the hose 12 and the tube 14 can have other dimensions.

The inner diameter F of one of the ends 16 and 30 of the hose 12 can be made larger or flared by inserting a plug or a mandrel 32 into the desired end 16 and 30 of the hose 12 to increase the inner diameter F of the hose 12 at the desired end 16 and 30. Figure 2 illustrates a hollow plug 32 inserted into the second end 30 of the hose 12. Although it is illustrated and described that the plug 32 is being inserted into the second end 30 of the hose 12, it is to be understood that a plug 32 can be inserted into the end 16 or into both ends 16 and 30. The plug 32 has a given length and expands the inner diameter of the hose 12 to an enlarged inner diameter G at the points where the plug 32 contacts the inner diameter F of the hose 12. As shown, the loading endcap 28 includes a hole 34 to allow for insertion of the plug 32. The length of the plug 32 also depends on the hose 12 requirements and customers specifications. Curing the hose 12 retains the flared shape of the end 30.

The hollow plug 32 allows the inside G of the hose 12 to vent, preventing the collapsing of the hose 12 during curing due to the pressure on the outside of the hose 12. By providing a vent, the atmospheric pressure on the inner surface and the outer surface of the hose 12 can be equalized. If a plug 24 and 32 is employed at both ends 20 and 30 of the hose 12, the plugs 24 and 32 must be hollow to allow the inside of the hose 12 to vent. If only one plug 32 is employed, the plug 32 can be solid, or a mandrel, as the other end of the hose 12 is open.

Although a hose pre-form 12 has been illustrated and described, it is to be understood that other pre-forms can be utilized. The pre-form 14 can also be a fuel line, a synthetic brake line, a reinforced hose, a non-reinforced hose, a seal or a gasket, either solid, hollow, dense and sponge.

By employing the hose forming assembly 10 of the present invention, the hose pre-form 12 can be easily loaded in the pre-shaped tube 14, reducing operator injuries. Trimming is also not required as the ends 16 and 30 are finished during the curing process. Additionally, less space is required as the assembly 10 eliminates the need for spacial considerations around the parts for the operator's hands. The tubes 14 are also stackable during the curing process, reducing space and allowing for more hoses 12 to be cured in a given area. There is also fewer external markings on the hoses 12. Finally, the assembly 10 is more economic and ergonomic than the prior art methods.

The foregoing description is only exemplary of the principles of the invention. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, so that one of ordinary skill in the art would recognize that

5 certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following claims should be studied to determine the true scope and content of this invention.



CLAIMS

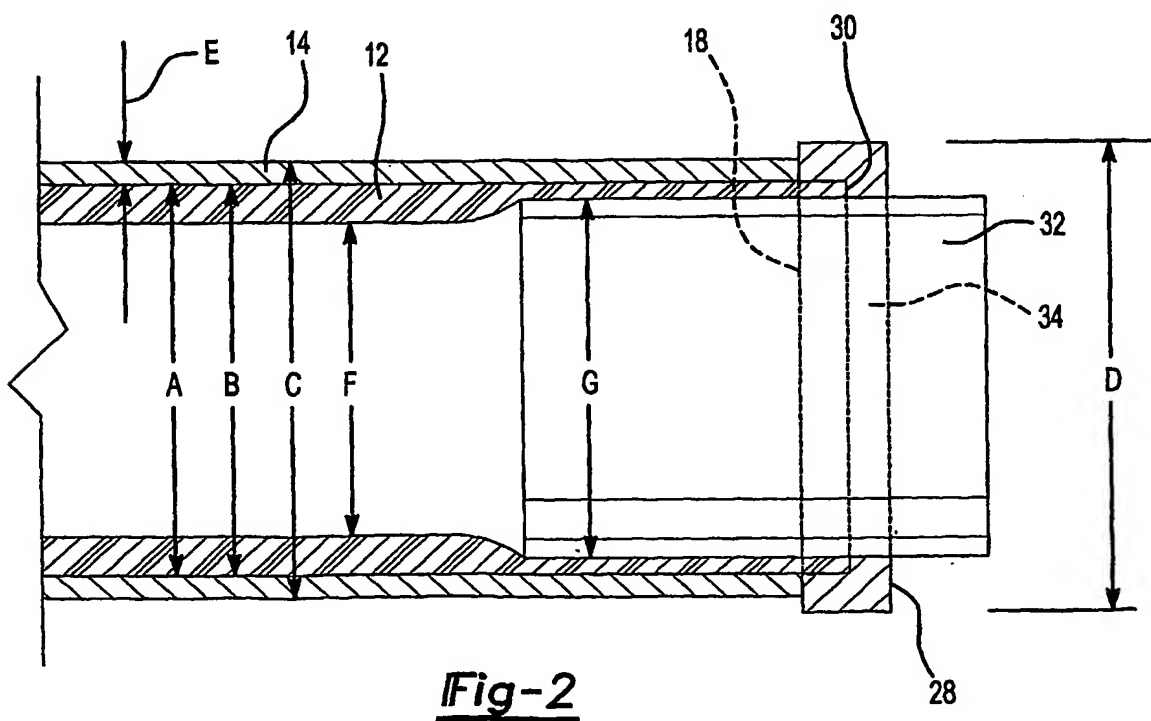
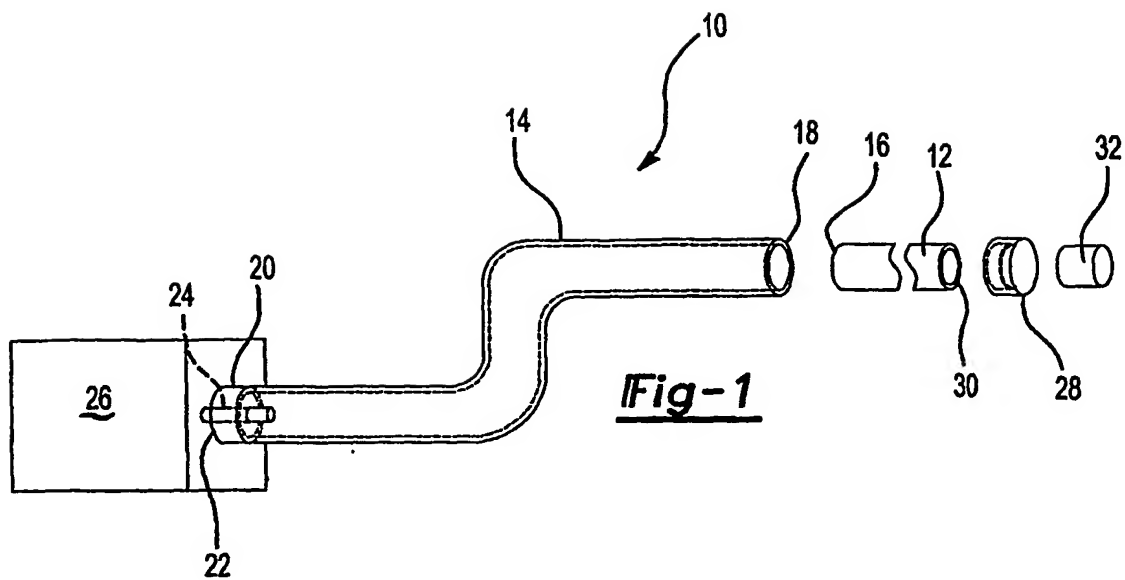
1. A method of forming a hose into a desired shape comprising the steps of:  
pulling said hose into a forming tube having an inner surface defining a  
5 desired tube shape;  
curing said hose into said desired shape; and  
removing said hose having said desired shape from said forming tube.
2. The method as recited in claim 1 further comprising the step of cutting said  
10 hose to a desired length.
3. The method as recited in claim 1 further comprising the step of holding said  
forming tube stationary.
- 15 4. The method as recited in claim 3 wherein a clamping block holds said  
forming tube stationary.
5. The method as recited in claim 1 further comprising the step of lubricating  
said hose.  
20
6. The method as recited in claim 1 wherein said hose includes a first end and a  
second end and said forming tube includes a loading end and a vacuum end, and the  
step of pulling includes inserting said first end of said hose into said loading end of  
said forming tube.  
25
7. The method as recited in claim 6 further comprising the steps of positioning  
a vacuum endcap on said vacuum end of said forming tube and positioning a loading  
endcap on said loading end of said forming tube.
- 30 8. The method as recited in claim 7 wherein the step of pulling said hose into  
said tube includes applying a vacuum to said vacuum end of said tube.

9. The method as recited in claim 6 wherein said first end of said hose is flush with said vacuum endcap and said second end of said hose is flush with said loading endcap.
- 5 10. The method as recited in claim 6 wherein the step of removing said hose includes applying a pressure to said vacuum end of said forming tube.
11. The method as recited in claim 6 further including the step of forming said first end and said second end.
- 10 12. The method as recited in claim 1 wherein said hose includes a first end and a second end, and the method further includes the step of flaring at least one of said first end and said second end of said hose.
- 15 13. The method as recited in claim 12 wherein at least one of said first end and said second end of said hose is flared by inserting a mandrel into said at least one of said first end and said second end of said hose, and said mandrel has an outer diameter greater than an inner diameter of said hose.
- 20 14. The method as recited in claim 1 wherein said hose is a polymer.
15. The method as recited in claim 1 wherein said forming tube is one of plastic, glass, Pyrex, ceramic, and metal.
- 25 16. The method as recited in claim 1 wherein said hose is cured by submerging said hose and said forming tube in a hot fluid.
17. The method as recited in claim 1 wherein said hose is cured by an electric wrap.
- 30 18. The method as recited in claim 1 wherein said hose is cured by microwaving.

19. A method of forming a hose into a desired shape comprising the steps of:  
cutting said hose to a desired length;  
lubricating said hose;  
pulling said hose into a forming tube having an inner surface defining a  
5 desired tube shape;  
curing said hose into said desired shape; and  
removing said hose having said desired shape from said forming tube.
20. The method as recited in claim 19 wherein said hose includes a first end and  
10 a second end and said forming tube includes a loading end and a vacuum end, and  
the step of pulling includes inserting said first end of said hose into said loading end  
of said forming tube.
21. The method as recited in claim 20 further comprising the steps of positioning  
15 a vacuum endcap on said vacuum end of said forming tube and positioning a loading  
endcap on said loading end of said forming tube.
22. The method as recited in claim 20 wherein the step of pulling said hose into  
20 said tube includes applying a vacuum to said vacuum end of said tube.
23. The method as recited in claim 20 wherein said first end of said hose is flush  
with said vacuum endcap and said second end of said hose is flush with said loading  
endcap.
24. The method as recited in claim 20 wherein the step of removing said hose  
25 includes applying a pressure to said vacuum end of said forming tube.
25. The method as recited in claim 19 wherein said hose includes a first end and  
a second end, and the method further includes the step of flaring at least one of said  
30 first end and said second end of said hose.

26. A method of forming a hose into a desired shape comprising the steps of:  
providing a hose including a first end and a second end;  
providing a forming tube including a loading end and a vacuum end;  
cutting said hose to a desired length;  
5 lubricating said hose;  
positioning a vacuum endcap on said vacuum end of said forming tube;  
pulling said hose into said forming tube having an inner surface defining a  
desired tube shape;  
positioning a loading endcap on said loading end of said forming tube;  
10 curing said hose into said desired shape; and  
removing said hose having said desired shape from said forming tube.
27. The method as recited in claim 26 wherein the step of pulling includes  
inserting said first end of said hose into said loading end of said forming tube.
- 15 28. The method as recited in claim 26 wherein the step of pulling said hose into  
said tube further includes applying a vacuum to said vacuum end of said tube.
29. The method as recited in claim 26 wherein said first end of said hose is flush  
20 with said vacuum endcap and said second end of said hose is flush with said loading  
endcap.
30. The method as recited in claim 26 wherein the step of removing said hose  
includes applying a pressure to said vacuum end of said forming tube.
- 25 31. The method as recited in claim 26 further including the step of flaring at least  
one of said first end and said second end of said hose.

1/1



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/00977

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 B29C53/08

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B29C B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 859 408 A (VOSS HAROLD C ET AL) 7 January 1975 (1975-01-07)	1-7, 9-21, 23-31
Y	the whole document	8,22
Y	EP 0 585 855 A (TOKAI RUBBER IND LTD) 9 March 1994 (1994-03-09)	8,22
A	the whole document	1-7, 9-21, 23-31
A	GB 1 031 640 A (IMP METAL IND KYNOCH LTD) 2 June 1966 (1966-06-02) page 2, line 43-49	1,16

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\* & \* document member of the same patent family

Date of the actual completion of the international search

15 May 2003

Date of mailing of the international search report

22/05/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+31-70) 340-3016

Authorized officer

Foulger, C

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/00977

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3859408	A	07-01-1975	BE 815223 A1 FR 2274423 A1 GB 1457026 A	16-09-1974 09-01-1976 01-12-1976
EP 0585855	A	09-03-1994	JP 6071736 A JP 2784563 B2 JP 6071734 A DE 69307056 D1 DE 69307056 T2 EP 0585855 A1	15-03-1994 06-08-1998 15-03-1994 13-02-1997 12-06-1997 09-03-1994
GB 1031640	A	02-06-1966	DE 1504410 A1 NL 6407766 A	05-02-1970 13-01-1965